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Abstract

RECENT DEVELOPMENTS IN THE FIELD OF REFRACTORY FUELS

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The main part of the work carried out in the field of ceramic fuels by the Commissariat à l'Energie Atomique during recent years, has been in the direction of uranium dioxide and the uranium-carbon alloys.

Uranium dioxide is being studied with the aim of using it as a fuel in the first core of EL-4, in which an integrated thermal conductivity of 29 W/cm is expected at the hottest point for a surface temperature of about 750°C.

We concentrated on developing a process for preparing a dioxide powder of suitable characteristics and for sintering this powder, and on evaluating the main properties of the material obtained in the light of the conditions under which they will be used :

- micro-structural aspect and pore distribution,
- mechanical and thermal behaviour in cylindrical form,
- control of excess oxygen in the industrial products,
- behaviour of the gaseous fission products at high temperatures after or during the course of irradiation.

Our aim in the case of uranium carbides has been to determine the conditions of industrial manufacturing of a suitable fuel with a composition close to UC.

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This has led us to undertake a number of fundamental investigations into :

- the domain of existance of non-stoichiometric UC,
- the influence of elements of O and N on the properties of the UC in which they are dissolved,
- the compatibility of uranium-carbon alloys with the different metallic or ceramic materials used for the sheath,
- the corrosion of uranium-carbon alloys by H_2O and CO_2,
- methods of preparing high purity samples,
- in-pile irradiation devices for the investigation of these materials in the region of possible operating temperatures.

In parallel with these fundamental investigations, we have attempted to define a proceedure for the fabrication of uranium-carbon alloys of composition very close to UC which would, in its industrial application, lead to better results than the existant methods from the technical or economical points of view (i.e. sintering or arc fusion). This latter method is based on fusion by electronic bombardment associated with the continuous casting.